OXFORD CRYOSYSTEMS

Cryodrive Compressor

Operation & Instruction Guide

CRYODRIVE HELIUM COMPRESSOR

Operation & Instruction Guide v2.4

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1 Introduction

1.1 Please register your Cryodrive!

In order to help us provide technical support, we need you to register your Cryodrive. You can do this by emailing the serial number together with your contact details to info@oxcryo.com. This is very important as it allows us to track your enquiry and tie this up with the technical notes we have on your particular system.

1.2 Scope of this Manual

This manual provides installation, operation and maintenance instruction for the Oxford Cryosystems Ltd Cryodrive Compressor systems. Read this manual before you attempt to install and operate the Cryodrive. The manual covers the Cryodrive 1.5, Cryodrive 2.0 and Cryodrive 3.0 and refers to the different models where appropriate.

This manual contains essential safety information that supplements the safety features of the Cryodrive. Safety procedures are highlighted as WARNING and CAUTION instructions. You must comply with these instructions. The use of WARNING and CAUTION is defined below.

Warning

Warnings are given where failure to observe the instruction could result in injury or death to person.

Caution

Caution is given where failure to observe the instruction could result in damage to the equipment, associated equipment and process.

This is used throughout this manual and conforms to the SI international system of units of measurements.

1.3 General Description

The Cryodrive supplies compressed helium gas (in a closed circuit) for between Oxford Cryosystems Coolstar Coldheads. These Coldheads may have been supplied as standalone units or may be integrated into Oxford Cryosystems Cobra, HeliX or PheniX systems, or third-party Cryostats. This manual should be used in conjunction with the manual for the relevant Oxford Cryosystems product.

The Coolstar Coldhead is fitted with a stepper motor. The rotational frequency of the stepper motor controls the frequency of the Coolstar Coldhead displacer cycle, which in turn, controls the cooling power of the Coldhead. The Cryodrive controls the frequency of the stepper motor in the Coolstar Coldhead. The main components of the Cryodrive are the compressor system (described in Section 1.6 entitled

Compressor System) and the CryoController (described in Section 1.7 entitled CryoController). The Cryodrive has three operation modes, described in Section 1.3.1 below and in more detail in Section 4.6.3 on page 24.

Note: If supplied with a Cobra, PheniX or HeliX, your Cryodrive is controlled by the Oxford Cryosystems Controller. In these cases, the separate control modes mentioned in Section 4.6.3 are not relevant.

The Cryodrive has one helium inlet (from the Coldhead return), one helium outlet (to the Coldhead supply) and two stepper-motor drive sockets. In some cases, multiple Coldheads) may be connected to these facilities with cable splitters and helium line T-pieces and X-pieces as described in Section 3.4 entitled Connection of the Coldhead. The Cryodrive is supplied fully charged with helium.

1.3.1 Operation

The Cryodrive may be operated in any one of three modes – Auto, Serial and PCSP – depending on the application of the Cryodrive, and whether external control of speed is required. More information on the modes can be found in Section 4.6.3 on page 24.

1.4 Cryodrive Safety Features

Warning

Do not adjust Cryodrive pressure relief valve. Doing so may cause a leak of high pressure helium from the Cryodrive that could cause injury to people nearby.

The Cryodrive has a number of safety features that are provided to ensure the safe operation of the Cryodrive, and Coldheads and Cryopumps connected to it. These safety features are summarized below. The Compressor system and the CryoController are described in more detail in Section 1.5 and 1.7.

Differential pressure relief valve	Limits the pressure differential between the compressor supply and return to 13.5 bar (196 psig). It allows the Cryodrive to be run with Coldhead(s) disconnected.
Pressure relief valve	This is the safety relief valve located on the manifold (see Figure 3) which vents to the atmosphere if the helium supply pressure rises above 30 bar (435.1 psig).
Pressure sensor	Shuts down the Cryodrive if the helium gas pressure at the Cryodrive helium return falls below a set point.
Temperature monitoring device	Protects the Cryodrive from excessive temperature. Inhibits start (PTAT) up or shuts down the Cryodrive if the temperature exceeds the set points.
Cryodrive protection switch	Protects the compressor motor from excessive electrical supply current. It has an adjustable current limit potentiometer to accommodate allowable supply voltages. When activated, it isolates the Cryodrive from the electrical supply.

Table 1 – Cryodrive safety features summary

1.5 Identification of controls, indicators and connections

The function of the Cryodrive controls, indicators and connections are described below.

Figure 1 and Figure 2 show the front and rear views of the Cryodrive and are also indicated by the numbered items shown in Table 2.

1. Pressure gauge
2. Mains supply in
3. Charge and vent port
4. ON/OFF (reset) switch
5. High temperature LED
6. Low pressure LED
7. Cryodrive ON LED
8. Elapsed hour counter
9. Serial cable connections
10. Coldhead 1 connection
11. Coldhead 2 connection

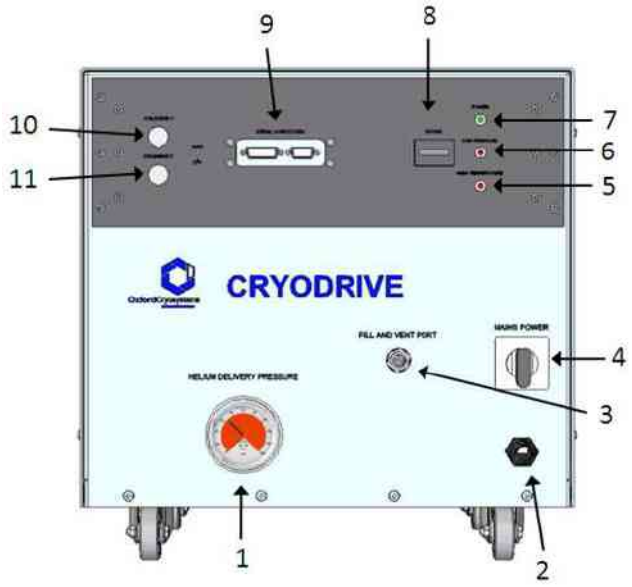

Figure 1 – Front view of the Cryodrive

12. Cooling water outlet
13. Cooling water inlet
14. Helium supply
15. Helium return

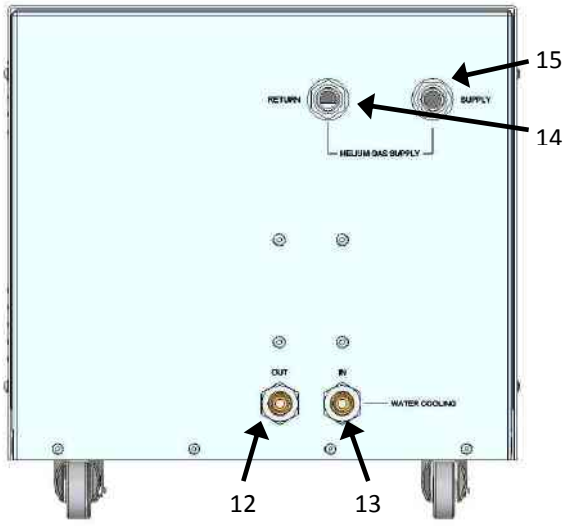

Figure 2 – Rear view of the Cryodrive

1	Pressure gauge	Indicates the helium pressure in the compressor system.
2	Mains supply in	Mains power cable is attached here.
3	Charge and vent port	¼ inch Aeroquip self-sealing coupling to charge or vent the Cryodrive with helium.
4	ON / OFF switch	Use this switch to turn the Cryodrive on and off. In the event of a shut down due to high temperature or low pressure, use this switch to reset the Cryodrive after you have corrected the fault.
5	High temperature LED	If the water return temperature is above 35ºC (±1ºC), this LED will flash. If the temperature is above 40ºC (±1ºC), the Cryodrive is shut-down and the LED is continuously lit.
6	Low pressure LED	If the Helium return pressure is less than 5.0 bar this LED will flash when running. If the pressure falls below 3.5 bar, the Cryodrive is shut down and the LED is continuously lit.
7	Cryodrive ON LED	After start-up check when the Cryodrive is switched on, the Cryodrive will start and this LED is continuously lit. If the Cryodrive is held off by the computer interface, this LED will flash.
8	Elapsed hours counter	Indicates total Cryodrive operating time in hours.
9	Serial cable connection	Cable connection between the Cryodrive and a computer.
10	Coldhead connection 1	Connection for Coldhead stepper motor cable
11	Coldhead connection 2	Connection for second Coldhead stepper motor cable.
12	Cooling water outlet connection	½ inch hose connection for cooling water outlet.
13	Cooling water inlet connection	½ inch hose connection for cooling water inlet.
14	Helium supply connection	½ inch Aeroquip self-sealing male coupling for connecting helium supply hose to coldhead.
15	Helium return connection	½ inch Aeroquip self-sealing male coupling for connecting helium return hose from coldhead.

Table 2 – Description of Cryodrive

1.5.1 Internal view of the Cryodrive

The internal view of the Cryodrive is shown in Figure 3.

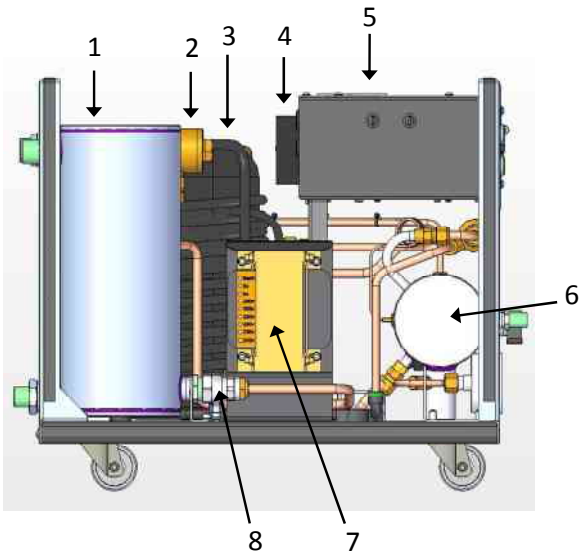

Figure 3 – Internal view of the Cryodrive, with the cover removed

1. Charcoal adsorber
2. Manifold
3. Compressor
4. Stepper driver heat sink
5. CryoController containing current protection switch
6. Coalescer
7. Transformer
8. Adsorber internal Aeroquip connection

1.6 Compressor System

The compressor system provides a constant supply of clean, compressed helium to the Coldhead at the correct operating pressure. The gas flow through the compressor system is illustrated in Figure 4.

1. Compressor
2. Heat exchanger
3. Coalescer
4. Adsorber
5. Oil return solenoid valve
6. Oil return capillary
7. Differential pressure-relief valve
8. Charge and vent port
9. System pressure relief valve
10. Low pressure warning sensor
11. Low pressure trip sensor
12. High pressure monitor (cooling circuit)
13. System pressure gauge
14. Cooling water outlet
15. Cooling water inlet
16. Helium supply
17. Helium return

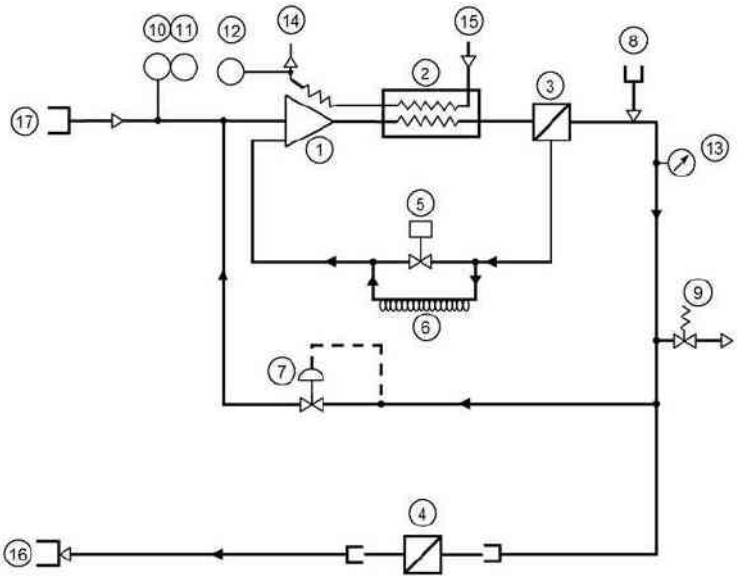

Figure 4 – Cryodrive circuit

With reference to Figure 4:

Helium is returned from the Coldhead at low pressure to helium return connection (17) and enters the oil-lubricated compressor (1). The helium is compressed to 21 bar (301.3 psig) and then passes through a water-cooled heat exchanger (2) to remove the heat generated during the compression cycle.

Next, the pressurised helium passes through the coalescer (3), where most of the oil is removed. This oil is periodically returned to the compressor sump through a solenoid valve (5), which automatically opens for 3 seconds every 2 hours, and also through a capillary (6) which is always open. On start-up, the solenoid valve (5) will stay open for 30 seconds allowing the compressor to warm up at low load. Then it closes and full load (22 bar) is applied.

The helium then passes through a charcoal adsorber (4), to remove any remaining oil vapour and contaminants. The helium is then supplied to the Coldhead from the helium supply connection (16).

A differential pressure-relief valve (7), pre-set to operate at 13.5 bar (196 psig), is connected across the compressor inlet and outlet. This valve limits the differential pressure across the compressor and so allows the Cryodrive to be operated safely with the supply and return hoses disconnected from the Coldhead.

The pressure gauge (13) measures the pressure of the helium on the compressor supply side. The charge and vent port (8) is used to add helium to the compressor system.

1.7 CryoController

The CryoController assembly is comprised of four components, the PCB controller, PCB driver#1, PCB driver# 2, and PCB interface.

The microprocessor contains all of the necessary software to run the Cryodrive or Coldhead(s) connected to it. The software has been configured to offer maximum control flexibility and protection to the equipment.

The software in the CryoController includes the possibility to reset the factory parameters setup. These parameters, which include the stepper motor frequency together with cool-down time, have been set to optimize the performance of your equipment. Section 3.3 describes how to select the correct set-up for your equipment installation.

You have two options for remote control. For more information about the connection and how to use the remote control facility please refer to Section 4.6. Use one of these options when you want to operate the Cryodrive compressor under remote control or if you want to monitor the Cryodrive signals.

2 Technical Data

Note

The Cryodrive is designed for use indoors only.

2.1 Operating and Storage Conditions

Maximum altitude (operation):	2000 m
Maximum humidity (operation):	80% RH up to 31˚C, decreasing linearly to 50% RH at 40˚C
Ambient temperature range (operation):	+8˚C to 40˚C
Pollution category (IEC1010):	2

2.2 Performance

Helium pressure (static):	16.5 +1.0 bar, 239.3 + 14.5 psig
Sound pressure level at 1 meter:	less than 75 db A

2.3 Mechanical Data

The dimensions are as follows:

Length:	560 mm
Width:	447 mm
Height:	450 mm
Weight (approximate):	80.0 Kg

2.4 Electrical Data

Number of phases:	1
Supply voltage:	200,220 or 240 V at 50 Hz
(User configurable):	200,208 or 220 V at 60 Hz
Supply voltage tolerance:	+10 %
Full load current:	see Table 3 – Full load current data

Fuses

Maximum supply fuse rating:	30A
Recommended CryoController fuse type:	Slowblow
Maximum CryoController fuse rating:	5A
Over voltage category (IEC664):	2 (local level)

Supply frequency and voltage		50Hz			60Hz		
		200 V	220 V	240 V	200 V	208 V	220 V
Cryodrive 1.5	Full load (A)	10.4	9.4	8.6	10.6	10.2	10.0
	Rating (KVA)	2.2	2.2	2.2	2.0	2.0	2.0
Cryodrive 2.0	Full load (A)	13	12	11	14	13.5	13
	Rating (KVA)	2.6	2.6	2.6	2.8	2.8	2.8
Cryodrive 3.0	Full load (A)	15.5	14.0	13.0	17.0	16.4	15.5
	Rating (KVA)	3.3	3.3	3.3	3.2	3.2	3.2

Table 3 – Full load current data

2.5 Cooling Water Requirements

Note

The required water quality is typical of a United Kingdom mains water supply.

For a Cryodrive 2.0 use a similar mapping as for the Cryodrive 3.0

Minimum flow rate:	1.5 litres/min
Maximum flow rate:	7.0 litres/min
Maximum supply pressure:	101.5 psig
Minimum water supply temperature (at start-up):	+4ºC
Maximum water discharge temperature:	+35ºC
Water quality pH range:	6.0 to 8.0
Maximum calcium carbonate concentration:	75 parts in 10^6

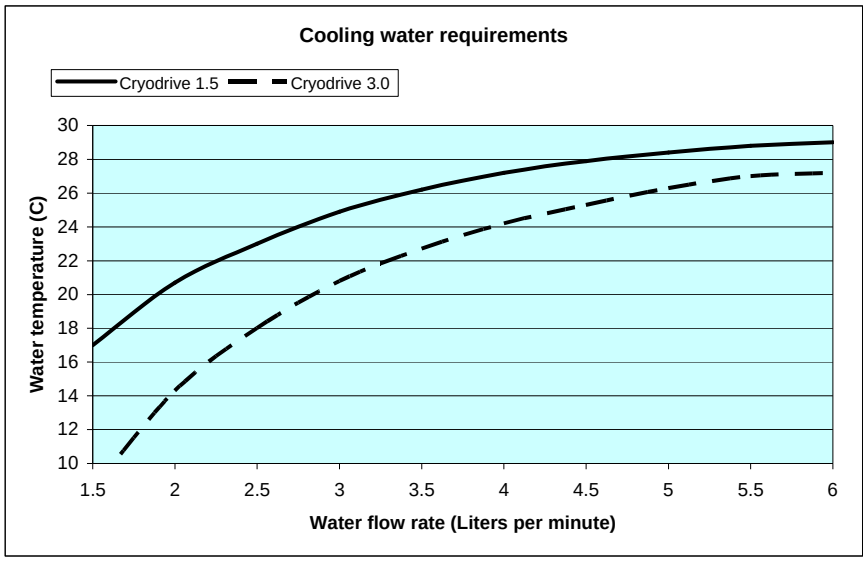

Figure 5 – Cooling water requirements

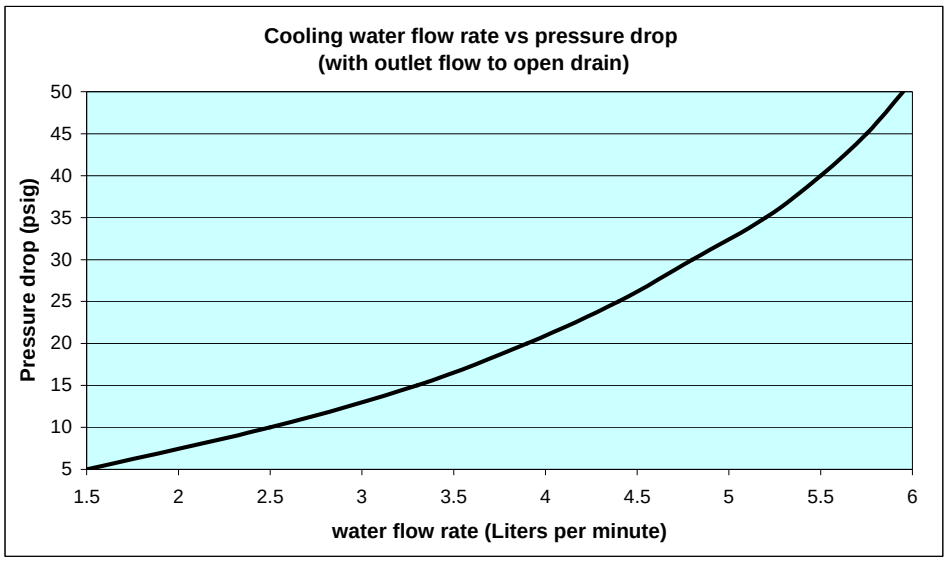

Figure 6 – Cooling water flow rate vs. pressure drop (with outlet flow to open drain)

2.6 Construction details

2.6.1 Legislation and standards:

The Cryodrive has been designed in compliance with the following legislation and standards:

2.6.1.1 EUROPEAN LOW VOLTAGE DIRECTIVE 73/023/EEC.

IEC 61010-1 - Safety Requirements for Electrical Equipment for Measurement Control and Laboratory Use.

2.6.1.2 EUROPEAN ELECTROMAGNETIC COMPATIBILITY-DIRECTIVE 89/336/EEC.

EN 61326 - Electrical equipment for measurement, control and laboratory use EMC requirements (1998).

2.6.1.3 EUROPEAN MACHINERY DIRECTIVE 89/392/EEC.

EN 1012-2 - Compressors and vacuum pumps - Safety requirements - Part 2: Vacuum pumps.

2.6.2 Construction materials

Steels, copper, glass fibre, charcoal, soft solder, mineral oil lubricant and miscellaneous electrical components.

3 Installation

3.1 Unpack and Inspect

Do not remove the Cryodrive from the pallet until you are ready to start installation. The fitting pack supplied with the Cryodrive contains a vent adaptor, a pack of Aeroquip gasket seals and water fittings.

- Remove all packing materials and inspect the exterior of the Cryodrive.
- Check that the pressure gauge reads 16.5±1.0 bar (239±14.5 psig). If the pressure is less than 15.5 bar, please contact Oxford Cryosystems Ltd to report this fact.

If the Cryodrive is damaged, notify Oxford Cryosystems Ltd and the carrier in writing within three days, stating the serial number of your Cryodrive together with your order number and Oxford Cryosystems Ltd invoice number. Return all packing materials for inspection and **do not use the Cryodrive**.

If the Cryodrive is not to be used immediately, replace the packing materials and store the Cryodrive in suitable conditions as described in Section 6.1.

3.2 Locating the Cryodrive

The Cryodrive can be located on the floor or on a bench, close to the Coldhead(s) that it supplies. If you locate the Cryodrive on a bench, you must push wedges under the castors to prevent the Cryodrive from moving.

Lift the Cryodrive from the pallet by hand or with a suitable hoist. If you lift the Cryodrive by hand, support the weight from the base of the unit.

Warning

Do not attempt to lift the Cryodrive on your own: seek assistance from at least one other person before doing so. If raising by hand, ideally the Cryodrive should be lifted by four people

3.3 CryoController Configuration

If making use of a third party cryostat with your Cryodrive, you must configure the Cryodrive to work with your particular system installation. If you change your system installation, you must re-configure your Cryodrive for the new installation.

Use the Cryodrive Pad program (refer to Section 4.6) to set the correct parameters for your system installation. The Cryodrive will not be damaged if you do not select the correct setup but this will result in a less than optimum system performance.

For full instructions on how to setup these parameters refer to Section 4.6

3.4 Connection of the Coldhead

Schematic illustrations of the stepper motor cable and helium hose configurations for connection of between one and four Coldheads to the Cryodrive is shown below.

3.4.1 Coldhead Stepper Motor Cable Connection

The Cryodrive has two Coldhead connection sockets for the connection of the stepper motor cable to your Coldhead(s). These sockets are on the front of the Cryodrive and are labelled Coldhead 1 and Coldhead 2.

If you connect more than one Coldhead to either of these Coldhead connection sockets, you must use one or more cable splitters, available as optional accessories (please contact Oxford Cryosystems Ltd, orders@oxcryo.com). The cable splitters allow up to two stepper motor cables to be connected to one Coldhead connection socket.

3.4.2 Helium hose connection

The Cryodrive has one helium supply outlet and one helium return inlet (Figure 2, Items 15 and 16). Helium hose connection is shown in Figure 7.

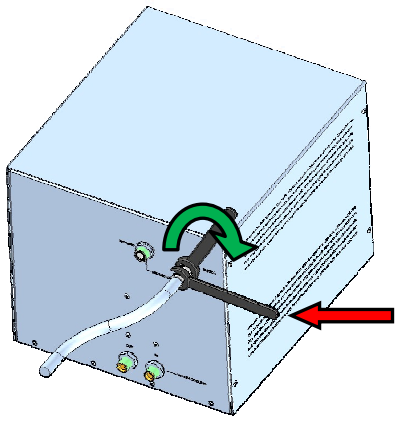

Figure 7 – Connection of a helium hose to the Cryodrive using two spanners

When connecting the helium hoses, makes sure you use two spanners to prevent damage to the couplings and leakage of the helium. One spanner is kept still (shown in the figure as the red arrow) whilst a second spanner is used to tighten the connection (as indicated by the green arrow). See procedure below.

If you want to connect more than one Coldhead to the Cryodrive, you must use one or more T-pieces or X-pieces to accept the additional helium hose(s). These optional accessories are available from Oxford Cryosystems Ltd (orders@oxcryo.com).

Note that the resulting pressure drop along the helium hoses may result in reduction in cooling power at the Coldhead.

Note also that helium hoses and T- and X-pieces are pressurised with helium. When you fit these components, you must follow the safety advice and instructions given in the instruction manual

supplied with them. Do not over bend or twist the helium hoses; do not allow damage to occur to the braid on the outside of the hoses.

Procedure is as follows:

- First, fit any T- or X-pieces that are required to both the helium supply and the helium return connectors.
- Check that the connecting surfaces of the couplings are clean.
- Check that the sealing 'O' ring is in place.
- Connect the coupling halves by hand until you feel resistance. Rotate the spanner as shown by the green arrow in Figure 7 to fully tighten the coupling.
- When the connection is fully made, rotate the spanner in the opposite direction for one complete turn to ensure that the sealing 'O' ring is not over compressed .If you over compress the sealing 'O' ring the service life of the fittings will be reduced.
- Repeat steps 1 to 4 until all of the necessary T- and X-pieces have been connected to the Cryodrive.

Next, fit the Coldhead helium hoses as described below, use the technique described above to make the connections.

- Connect the hose marked with the red band to the helium supply connector on the Cryodrive: connect the hose directly to the helium supply connector or to one of the free ends of a T- or X-piece, as appropriate. Connect the other end of the hose to the helium supply connector (marked with a red band) on the Coldhead.
- Connect the hose marked with the green band to the helium return connector on the Cryodrive: connect the hose directly to the helium return connector or to one of the free ends of a T- or X-piece, as appropriate. Connect the other end of the hose to the helium return connector (marked with a green band) on the Coldhead.
- Repeat the above procedure to install additional pairs of hoses, as required for your Coldhead installation.

3.5 Cooling water connection

- Use hose clips to secure suitable water hoses (1/2-inch nominal internal diameter) to the water connection nozzles (supplied in the fitting pack).
- Connect the supply and return hoses to the cooling water inlet and outlet connectors as marked on the rear of the Cryodrive (Figure 2, items 12 and 13).
- Connect the water supply hose to cooling water supply with an adequate flow rate and temperature (see Section 2.5).
- Connect the water return hose to a suitable drain.
- Turn on the cooling water supply and check that there are no water leaks.

3.6 Electrical Supply Connection

We recommend that you use a suitably fused isolator at your electrical supply outlet. Locate the isolator switch close to the electrical outlet. We also recommend that you install back-up fuses at the electrical supply outlet. Details of suitable fuses are given in Section 2.

You must configure the Cryodrive to suit your electrical supply. The Cryodrive is dispatched configured for use with 240 V and 50 Hz.

Use the procedure below to change this configuration.

- Look at Table 4: find your electrical supply in the left-hand column, look along this row to find the connections you must make for the wire 30(W30) and wire 31(W31).

- Remove the lid of the Cryodrive and locate the transformer (see, Item 7).

- With reference to Figure 8, change the position of wire 30 (W30) and wire 31 (W31) so that they are in the correct position for your electrical supply. Ensure the connections are fully tightened. **Do not move the wires attached to the red 0 V and 230 V connectors, as these provide power to the secondary stepper motor transformer and are not part of the procedure.**

- Locate the protection switch on the current-limit potentiometer which is situated in the CryoController, refer to Figure 9. The switch can be accessed by removing the lid of the CryoController unit.

- Look at Table 5: find your Cryodrive type and electrical supply frequency in the left-hand column, look along this row to find the recommended limit for the protection switch current.

- Use a small screwdriver to adjust the current-limit potentiometer to the recommended value.

- Replace the lid of CryoController and the Cryodrive.

- Make sure that the Cryodrive ON/OFF switch is in the OFF position and connect the Cryodrive to your electrical supply.

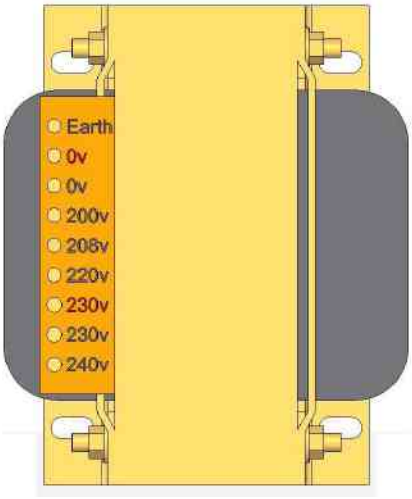

Figure 8 – Transformer showing different electrical supply connections

Electrical Supply	Primary Tap Connection					
	N	200V	208V	220V	230V	240V
50Hz, 200 V	W32	W31	W30	-	-	-
50Hz, 220V	W32	-	W30	W31	-	-
50Hz, 240V	W32	-	W30	-	-	W31
60Hz, 200V	W32	W31	-	-	W30	-
60Hz, 208V	W32	-	W31	-	W30	-
60Hz, 220V	W32	-	-	W31	W30	-
60Hz, 240V	W32				W30	W31

Table 4 – Wire connections to primary tap connections

Cryodrive model	Electrical supply voltage			
	200V	208V	220V	240V
Cryodrive 1.5, 50 Hz supply	11A	-	10A	10A
Cryodrive 1.5, 60 Hz supply	11A	11A	11A	-
Cryodrive 2.0, 50 Hz supply	14A	-	13A	12A
Cryodrive 2.0, 60 Hz supply	15A	14A	14A	-
Cryodrive 3.0, 50 Hz supply	16A	-	16A	16A
Cryodrive 3.0, 60 Hz supply	18A	17A	16A	-

Table 5 – Recommended protection switch current limit setting

3.7 Installation Check-List

Check that, as a minimum, you have completed the following installation procedures (see Table 6). If you have not, you may damage your Cryodrive when it is switched on.

Installation check	Reference	Tick box
Check that Cryodrive is not damaged	3.1	
Check that Cryodrive pressure is between 15.5 and 17.5 bar	2.2	
Set the controller parameters according to your system installation.	3.3	
Stepper motor cables connection	3.4.1	
Helium hoses connection	3.4.2	
Connect the cooling water supply	3.5	
Configure the Cryodrive for your electrical supply	3.6	
Set the protection switch current -adjustment	3.6	

Table 6 – Installation checklist

4 Operation

4.1 Start-up Procedure

Note

If you start the Cryodrive and the water supply temperature is lower than 4°C, the lubricating oil in the compressor will be very viscous. This may cause the compressor motor current to rise above the protection switch current-limit (see Section 3.6) and the protection switch will trip. Re-set the protection switch and re-start the Cryodrive as described in Section 4.3, ensuring that the cooling water supply temperature is above 4°C before you attempt to re-start.

- Switch on the cooling water supply.
- Switch the front panel ON/OFF switch to ON.

4.2 Automatic Re-start

On initial start-up or, following an interruption of the electrical supply, the compressor will automatically restart with the Coldhead(s) in the cool-down sequence. This allows the Coldhead(s) to run at high cooling power which gives the best chance of recovery. If overheating occurs, the Cryodrive will cease to operate. It will automatically re-start when the temperature has decreased to the normal limits.

4.3 Re-start after the Protection Switch has tripped

With reference to Figure 9 follow the procedure to re-start the Cryodrive after the protection switch has tripped.

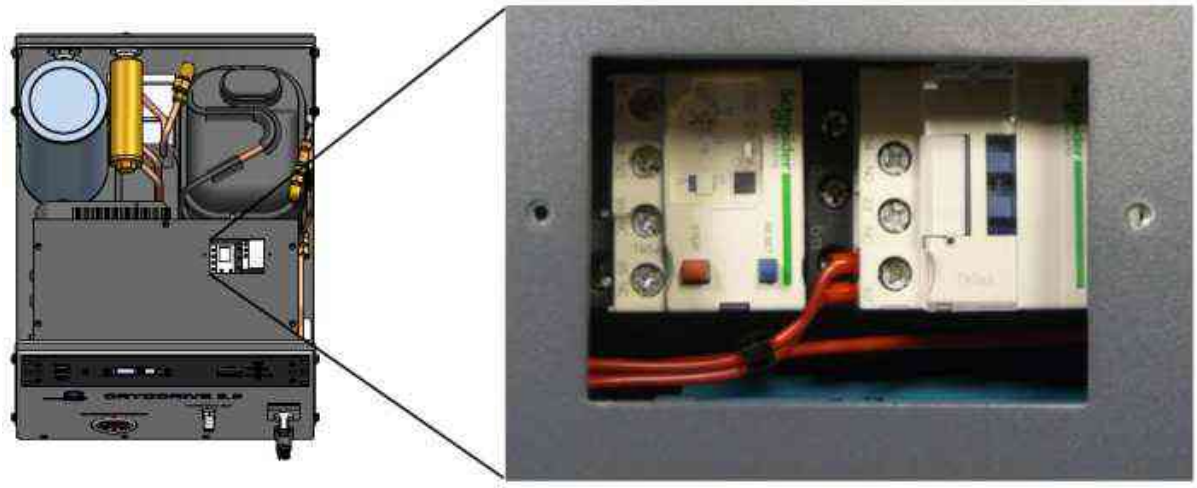

Figure 9 – Overload relay showing stop and reset buttons

Re-starting the Cryodrive after the protection switch has tripped:

- Switch the front panel ON/OFF switch to OFF.
- Remove the lid of the Cryodrive and the lid of the CryoController.
- The protection switch is located towards the back right of the CryoController as you face the Cryodrive (see Figure 9).
- Refer to Section 3.6 and Table 5 and check that the protection switch current limit is set correct. Adjust the current limit if necessary.
- Press the blue button marked 'reset' on the protection switch.
- Replace the lid.
- Switch the front panel ON/OFF switch to ON.

4.4 Manual Shut-Down

To manually close-down the Cryodrive, follow the procedure below.

- Switch the front panel ON/OFF switch to OFF.
- Turn OFF the cooling water supply.

4.5 Automatic Shut-Down

If the current drawn by the compressor motor rises above the current-limit of the protection switch, the protection switch will trip and the Cryodrive will shut down. You must manually re-set the protection switch before you can re-start the Cryodrive: follow the procedure in Section 4.3.

4.6 Operation Using the Cryodrive Pad Software

The Cryodrive Pad software is found on the CD packed with the Cryodrive or may be downloaded from the Oxford Cryosystems website at www.oxcryo.com.

Using the software, it is possible to:

- Monitor Cryodrive status parameters such as water temperature, helium pressure and coldhead speeds.
- Configure the default mode of operation, including adjusting the coldhead speed parameters for use in Auto mode.
- Remotely control the coldheads directly or else configure control using the separate Parallel Command and Status Port described in Section 4.7.

4.6.1 Connecting to Device

Cryodrive Pad requires that one of your computer's COM ports is connected to the right-hand (9-pin) serial connection port on the front of your Cryodrive. This connection can be made using the lead shipped with your Cryodrive or with a standard serial connection lead.

When you have connected and switched on your Cryodrive, start Cryodrive Pad . The first time you run the program you will be directed to the Settings Page to enable you to choose a COM port as described in the following section.

4.6.2 Settings Page

Connection: These items are used to specify and open the correct COM port. The first time you use the program, select your chosen COM port from the Connect Using Port item and press Connect. Note that if your COM port does not appear in the list then you may enter its name directly. On subsequent use the connection is performed automatically, provided the COM port is not in use when Cryodrive Pad starts. You may manually connect or disconnect from the COM port at any time using the Connect and Disconnect buttons. Note: if you wish to connect to more than one device from the same computer, start a new copy of Cryodrive Pad for each device and select different COM ports as appropriate.

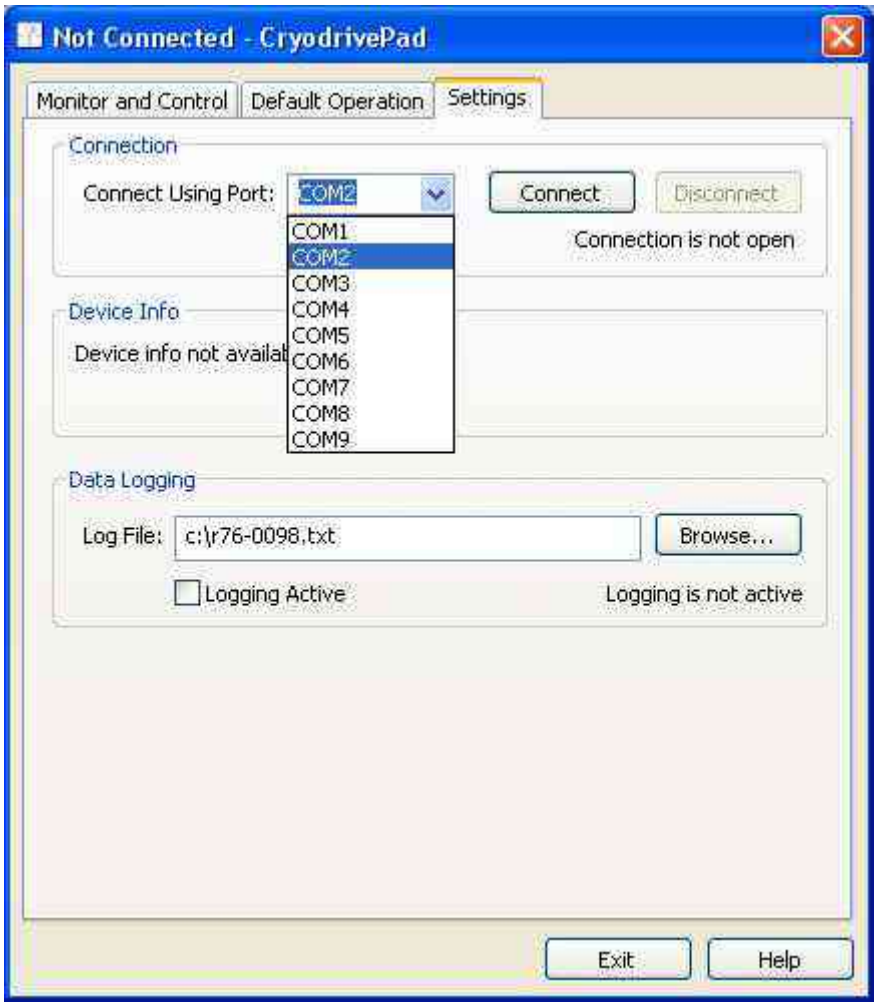

Figure 10 – Cryodrive Pad Settings Page (before connection is established)

If at any time the connection to the controller is lost (for example the lead is removed or damaged, or the Cryodrive is switched off), the icon in Cryodrive Pad's title bar will change to a grey question mark. Cryodrive Pad is still listening for incoming information, and if the connection is restored then Cryodrive Pad will recommence normal operation.

Once a connection has been established, the Settings Page will look as shown in Figure 12, with the Device Info and Data Logging sections activated.

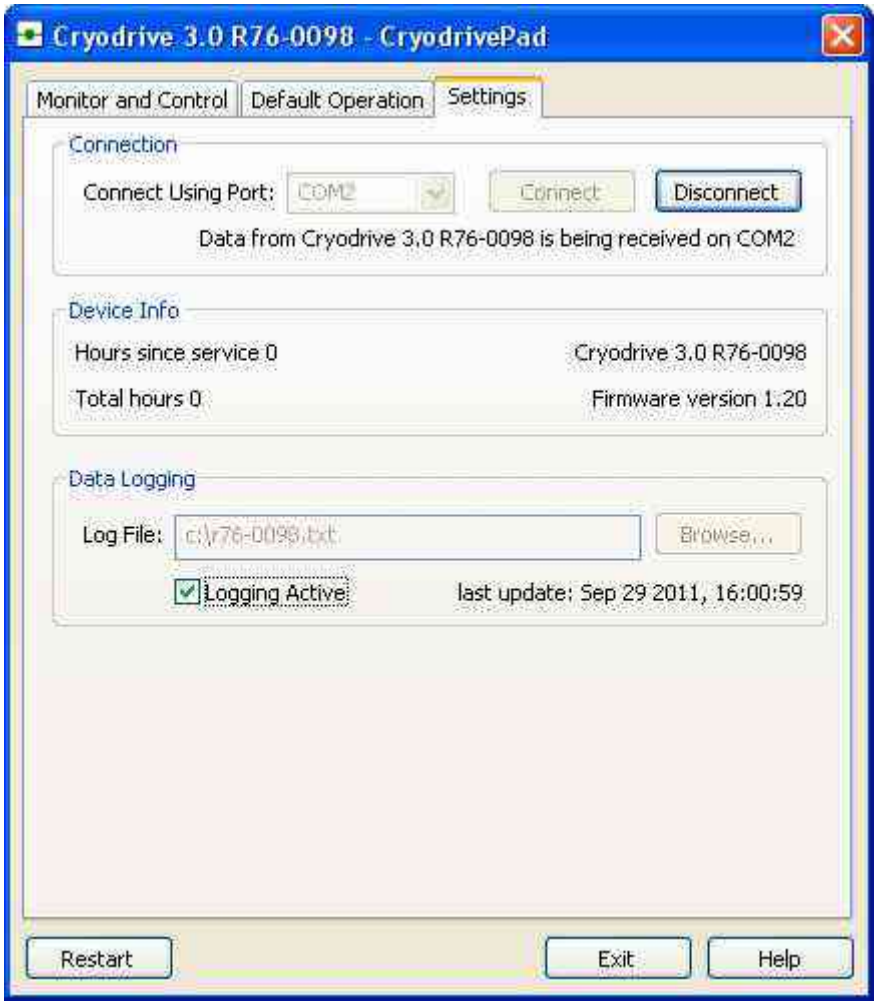

Figure 11 – Cryodrive Pad Settings Page (while connected)

Device Info: This area displays information about your device, including the total hours, hours since last service, type of Cryodrive, serial number and firmware version.

Data Logging: Cryodrive Pad allows quantities of interest to be logged in a tab-delimited text file. Enter the name of the file which will hold the log and then check the Logging Active item. Data will be continuously appended to the file you have nominated, which can then be imported into Excel or a similar program for analysis and graphing.

4.6.3 Monitor and Control Page

The Monitor and Control page is shown in Figures 13 and 14 It is updated once per second and presents information on the running of your device as well as allowing the coldhead speeds to be adjusted (depending on the Control Mode).

Cryodrive Status: This area summarises the condition of your Cryodrive, including the temperature of the cooling water and the status of the helium pressure within the device. Should a fault occur details will appear here and the frame icon will be changed to a red exclamation mark.

Coldhead Speed Control: These controls allow the speeds of the attached coldheads to be viewed and controlled. The options are listed below.

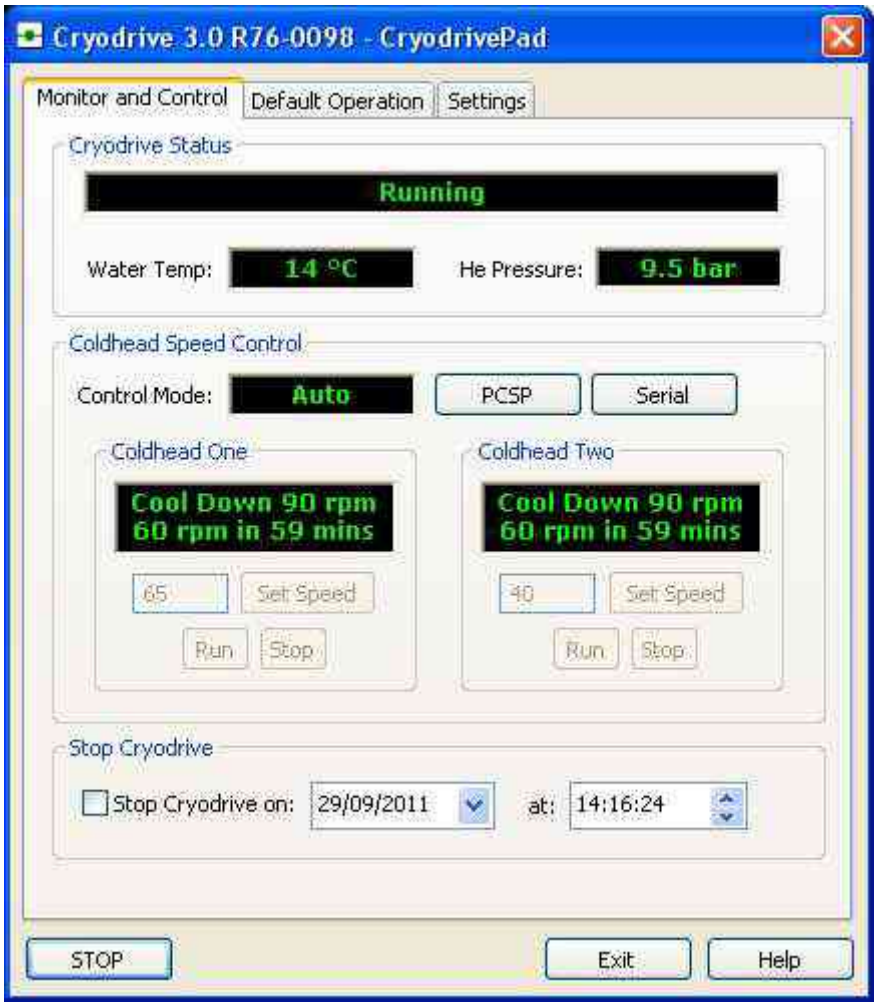

Figure 12 – Cryodrive Pad Monitor and Control Page (Auto Control Mode)

Control Mode: The coldhead speeds may be controlled in three distinct ways which are explained below.

- *Auto Mode*. When the Cryodrive is first switched on each coldhead is run for a limited time at a higher speed before reverting to a lower speed, which is maintained until the device is switched off. No external speed control is required. The default configuration is 90 rpm for 60 minutes and then 60 rpm.

- *PCSP Control Mode.* This is a specialised mode in which the coldhead speeds are controlled using the Parallel Command and Status Port (PCSP) – the left-hand (15-pin) connector port on the front of the Cryodrive. Details of this mode are given below in section 4.7.

- *Serial Control Mode.* In this mode the coldhead speeds are controlled directly using Cryodrive Pad.

The current control mode is indicated in green in the black box and the two buttons PCSP and Serial may be used to switch between these modes. To initiate Auto Mode it is necessary first to set this as the default mode and then to restart your Cryodrive

Coldhead One, Coldhead Two: The speeds of the coldheads are indicated in green in the black boxes. If the device is operating in Auto Mode, this display will include an indication of the status of the initial cool-down. If Serial Control Mode is selected then the coldheads may be controlled using the Set Speed, Run and Stop buttons as illustrated in Figure 13.

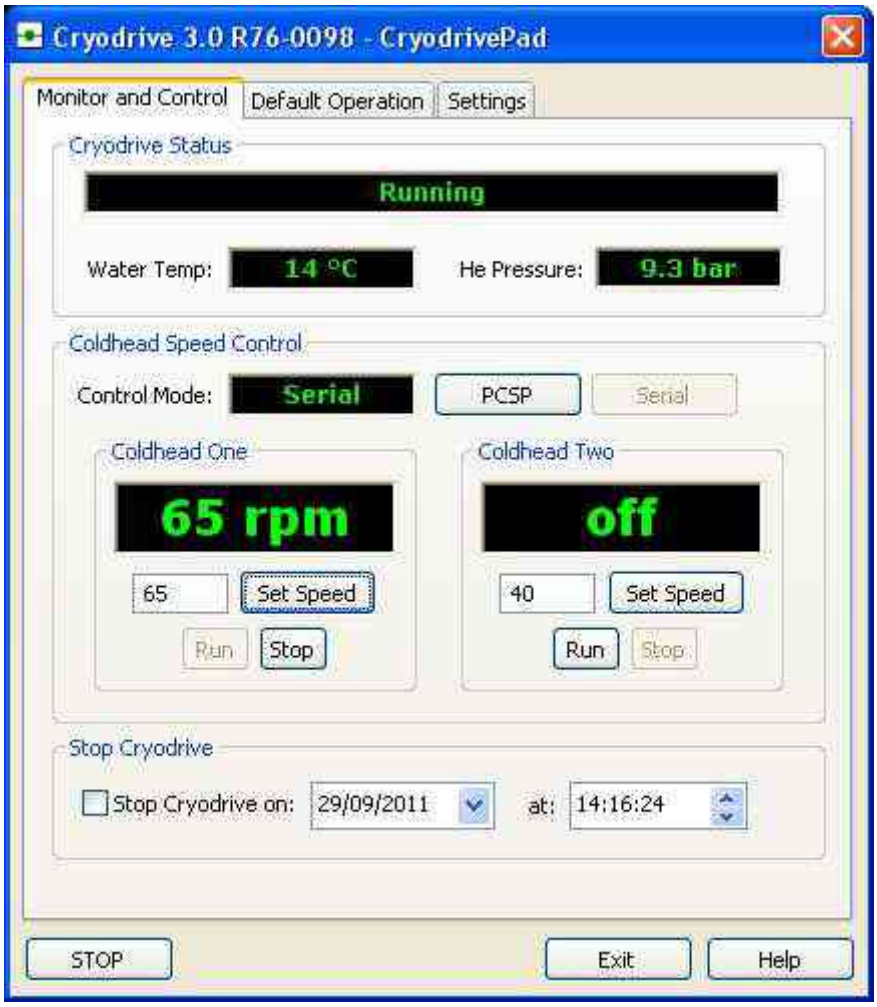

Figure 13 – Cryodrive Pad Monitor and Control Page (Serial Control Mode)

Stop Cryodrive on: If this box is checked then the Cryodrive will be stopped at the specified time. Please note, Cryodrive Pad must be running and connected at the given time for this to occur. To stop your Cryodrive immediately, press the Stop button at the bottom left of the Cryodrive Pad window. When Cryodrive is in stand-by, this button is replaced with the Restart button, which restarts Cryodrive in its default mode.

4.6.4 Default Operation Page

As explained above there are three distinct control modes. The Default Operation Page (Figure 14) is used to control which of these modes is used when the Cryodrive is switched on. Once set, this information is stored in the Cryodrive's non-volatile memory.

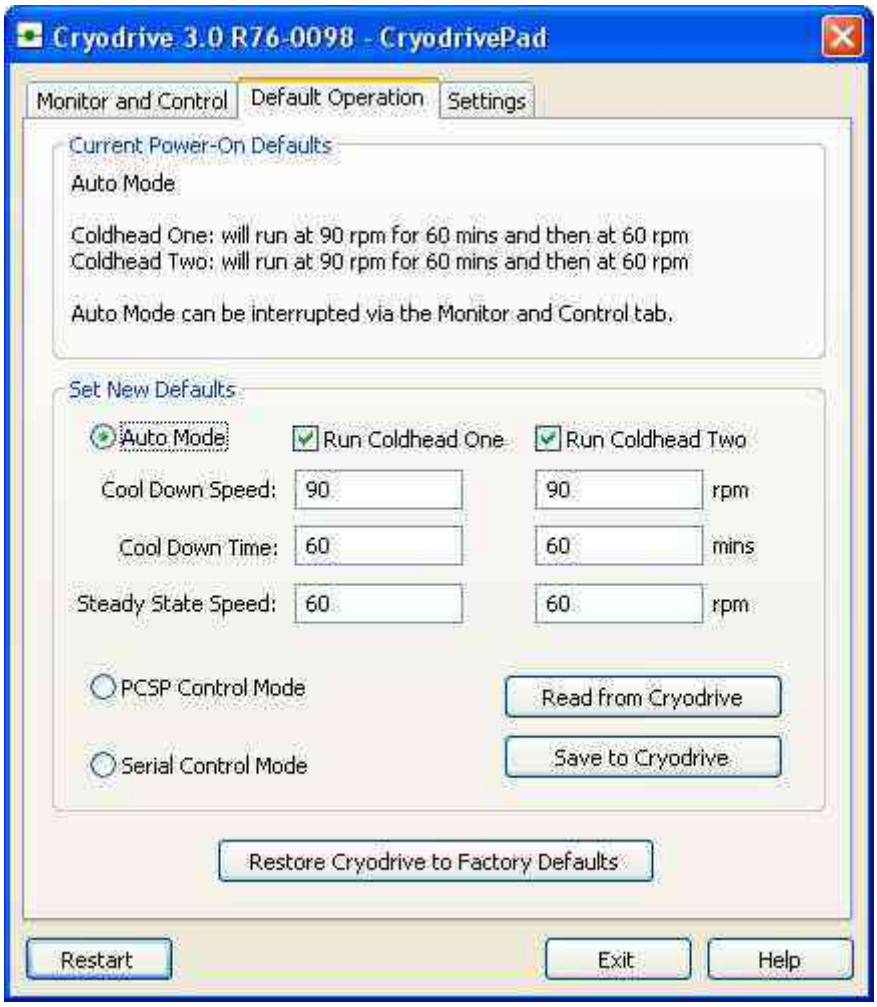

Figure 14 – Cryodrive Pad Default Operation Page

Current Power-On Defaults: This section displays the current default mode stored in the Cryodrive.

Set New Defaults: This allows a new set of defaults to be specified. Press Read from Cryodrive to copy the current defaults into these controls, and Save to Cryodrive to write your new defaults into the Cryodrive's non-volatile memory. The Restore Cryodrive to Factory Defaults buttons will set the following as the power-on default: Auto Mode, run both coldheads at 90 rpm for 60 mins before reverting to a steady-state speed of 60 rpm.

The new defaults will not take effect until Cryodrive is restarted.

4.6.5 Serial line control protocols

The protocols used by Cryodrive Pad to communicate with Cryodrive are published at www.oxcryo.com/serialcomms/gm/ in order to allow users to integrate an Oxford Cryosystems cooler into custom control systems. This may also be achieved using the PCSP mechanism described in the next section.

4.7 Remote Operation with PCSP (Parallel Command and Status Port)

To take advantage of this feature the Cryodrive must first be set in PCSP Control Mode as described above. The coldhead speeds can then be controlled using the Parallel Command and Status Port (PCSP) – the left-hand (15-pin) connector port on the front of the Cryodrive. This option provides you the capability to control the system by designing your own device. Technical data and interface are given below.

- The functions of the PSCP pins are shown in Table 7. Note that Pin No. 6 is 0V common for logic and analog input and Pin No. 7 is 5V for analog signal.

- Switching both CH1 and CH2 to "Close" position activates Cryodrive Off. Switching any channel to "Open" (CH1 or CH2 - Pins 4 or 8), activates Cryodrive On.

PCSP Pin. No. (D15 Connector.)	FUNCTION
1	Channel 2 stand-by/analog
2	Channel 1 boost on/off
3	Channel 2 boost on/off
4	Channel 2 on/off (Cryodrive on/off)
5	12V Signal
6	0V Common
7	5V Signal
8	Channel 1 on/off (Cryodrive on/off)
9	Channel 1 stand-by/analog
10	Channel 2 boost Led signal
11	Not in use.
12	Low pressure warning/trip LED signal
13	Cryodrive On/Off LED signal
14	Channel 1 boost LED signal
15	High Temperature warning/trip LED signal

Table 7 – PCSP interface pin function

4.7.1 Recommended remote operation circuit:

Figure 15 shows a suitable circuit to monitor the Cryodrive status.

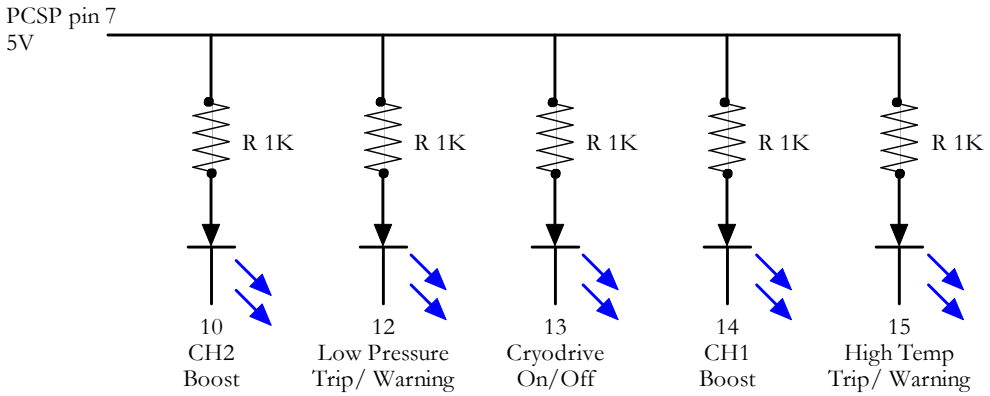

Figure 15 – PCSP monitoring function LED indicators

Figure 15 shows a suitable circuit to access the logic inputs. The figure shows the required setup for normal start-up. The functions shown in the figure are activated when the corresponding switch is open. For example, if you open the switch between pins 3 and 6 this will activate the boost speed (90 rpm) of channel 2. If you close this switch channel 2, the speed will return to the default setup.

Figure 16 shows a suitable circuit to access the analog inputs. Use these inputs if you want to control the stepper motor frequency signal to the drive channels.

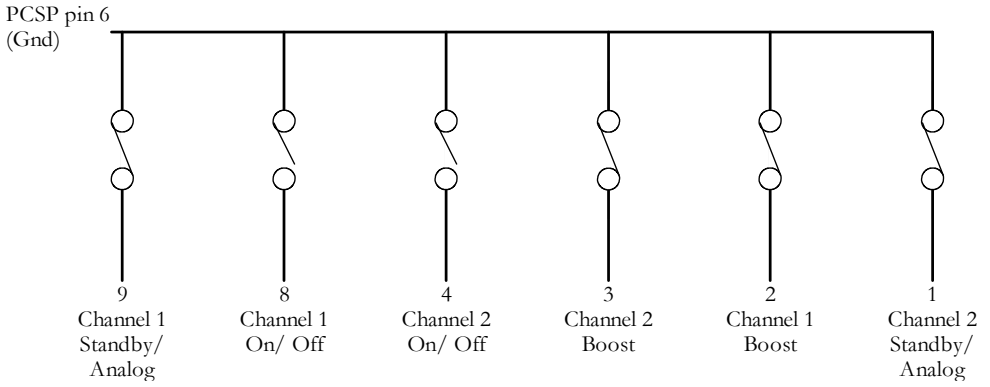

Figure 16 – PCSP control function switches

The stepper motor frequency varies linearly with input voltage. 0V DC is equivalent to 40 rpm and 2.5 V DC is equivalent to 90 rpm.

Do not operate the Coldhead at above 72 rpm for longer than needed, as this will increase wear on the seals, resulting in reduced service intervals.

5 Maintenance

As with all mechanical equipment, some maintenance is required to prevent degeneration of the Cryodrive. The adsorber must be replaced approximately every 15,000 hours (Section 5.2) and the system may require a Helium recharge with time (Section 5.3). The Cryodrive does not need to be cleaned to maintain performance or safety. If a fault occurs, tests can be used to diagnose the problem (Section 5.4 and Table 8)

5.1 Precautions

Warning

Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to persons and damage to equipment.

- A suitably trained and supervised technician must perform maintenance work.
- Wear the appropriate safety clothing.
- Check that all the required parts are available and of the correct type before starting work.
- Isolate the Cryodrive from the electrical supply so that it cannot be operated accidentally. If possible, remove the fuse from your electrical supply current and lock the isolator switches to the OFF position.
- Leak-test the system after maintenance work is complete; seal any leaks found.

5.2 Replacing the Adsorber

Warning

Do not bend over the internal pipe work when you fit and remove the Adsorber. After removal, the old Adsorber must be safely depressurized before disposal. The replacement Adsorber will be charged with helium to 16.5 bar. Always vent gas safely, directed away from personnel.

When the Cryodrive has been operating for approximately 15,000 hours, you must replace the Adsorber with a new one to avoid permanent damage to the Coldhead. Please contact Oxford Cryosystems Ltd for more information.

The new Adsorber is supplied pressurised with helium, so you should not have to re-charge the Cryodrive with helium after you fit the new Adsorber. A de-pressurisation adapter is supplied with the new Adsorber.

If necessary, refer to Section 7 for details of how to connect and disconnect the self-sealing Aeroquip coupling used for the Adsorber in the Cryodrive.

Replacing the Adsorber:

1. Switch the Cryodrive ON/OFF switch to OFF, isolate the Cryodrive from the electrical supply.

2. Remove the lid of the Cryodrive.

3. Disconnect the helium supply hose located at the rear of the Cryodrive.

4. Disconnect the Aeroquip coupling from the Adsorber inlet.

5. Unscrew and remove the Adsorber rear panel locking nut and washer. Remove the single screw retaining the Adsorber inlet connection clamp plate. Lift the Adsorber out of its locating hole and remove the Adsorber. Remove the locking nut and clamp plate from the Adsorber inlet connection. Retain the clamp plate and screw, locking nut, washer and star washer.

6. Depressurise the old Adsorber by connecting the depressurisation adaptor to the Adsorber helium inlet and outlet coupling and tighten slowly by hand.

7. Remove the dust from the inlet and discharge self-sealing couplings of the new Adsorber. Fit the Adsorber clamp plate and locking nut to the Adsorber Aeroquip inlet connection.

8. Install the new Adsorber in position in the compressor unit and ensure that the locating pin is correctly engaged. Secure the new Adsorber in place using the nut and washers, and Adsorber clamp plate screw retained in step 5.

9. Re-connect the helium supply hose. Re-connect the internal Aeroquip on the Adsorber inlet.

10. Re-fit the lid of the Cryodrive.

Check that the pressure gauge reads 16.5±1.0 bar (239.31±14.5 psig). If the gauge reads below 15.5 bar, add helium gas following the procedure detailed in Section 5.3.

Record the date the new Adsorber is fitted. Also record the hours run from the compressor hour counter.

5.3 Re-charging the Cryodrive with Helium

Warning

The Cryodrive is charged with high pressure Helium gas. When handling Helium gas, wear correct eye protection. Refer to all local health and safety regulations for compressed gas handling and dispensing.

You must re-charge the Cryodrive with 99.999% helium. If you do not, you will contaminate the coldhead with impurities that will reduce its efficiency.

The helium in the Cryodrive will eventually leak out over time and will require topping up from a high pressure helium gas cylinder (99.9995%). Each Cryodrive is supplied with a Cryodrive top up valve, which should be used to connect the cylinder to the front of the Cryodrive, via a single-stage high

pressure helium regulator and a suitable hose. Ensuring that the tubing to the fitting is purged with helium first, the cylinder can be opened and the helium can be quickly topped up to 16.5 bar. **Note that this should only be performed when the system is off.**

Re-charge the Cryodrive with helium if the helium pressure falls to below 15.5 bar. If you need to re-charge the Cryodrive frequently (for example, every 6 months or more often), there is probably a leak in your installation. Use a helium leak detector or other suitable method to find the leaks, and contact Oxford Cryosystems with the results, or for further guidance.

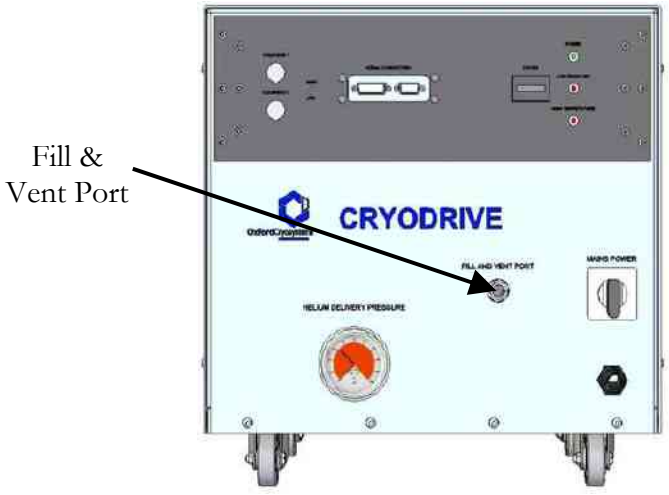

Figure 17 – Cryodrive fill and vent port

To add helium gas, you will require the following items (see Figure 18):

- Helium top-up valve (supplied)
- Cylinder of 99.9995% Helium gas with minimum of 30 bar (435 psi)
- Single stage high pressure Helium regulator (to supply 240 psi / 16.5 bar) for Helium cylinder
- Wrenches to attach regulator to cylinder, and top-up valve aeroquip to Cryodrive.
- Hose and fittings to connect the Helium top-up valve to the regulator.

Caution

Ensure that the interconnecting pipe work is capable of safely withstanding the maximum regulator delivery pressure.

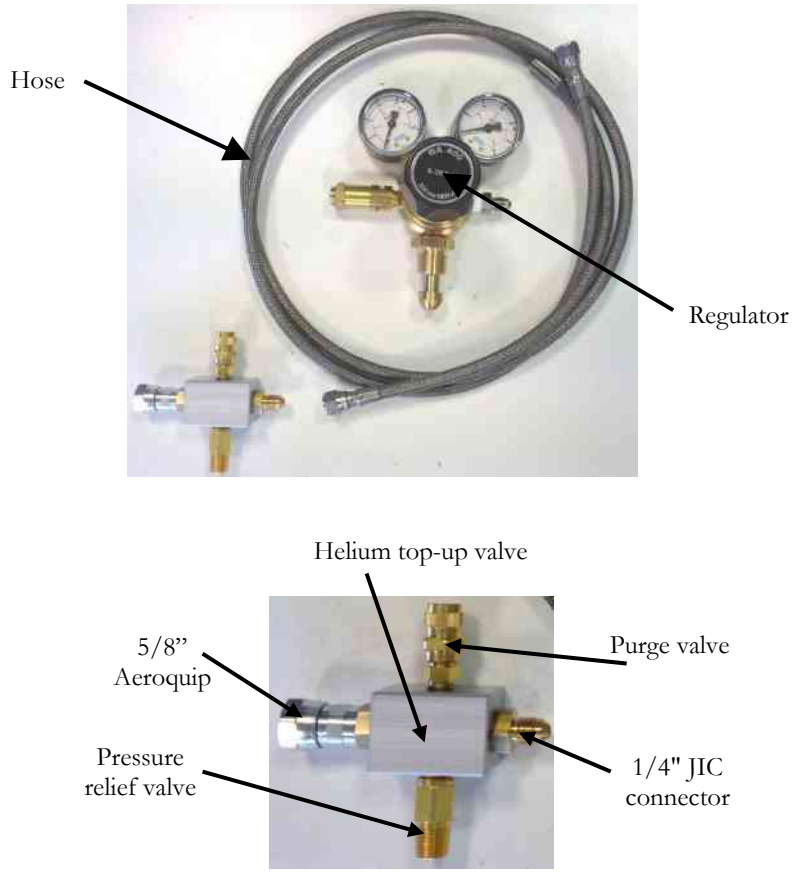

Figure 18 - Necessary equipment for helium top-up

Instructions:

1. Before topping up the Cryodrive with Helium, it is necessary to purge the hose to prevent air from getting into the Helium circuit of the system. This can be done quite simply. Fit the regulator to the Helium cylinder and before fitting the Helium top-up valve to the end of the hose, purge the hose with a flow of Helium from the cylinder. Reduce the flow to a minimum as the Helium top-up valve is being fitted to the end of the hose.

2. Once the valve is attached to the purged line, open the flow fully and regulate the pressure to 16.5 bar.

3. Locate the 'Fill and Vent Port' on the front of the Cryodrive (Figure 17).

4. Using two wrenches to ensure the aeroquip remains gas-tight, screw the Helium top-up valve to the Fill and Vent Port long enough to allow the pressure in the Cryodrive to equalise to 16.5 bar (240 psi). This level is indicated by the black line on the 'Helium Delivery Pressure' gauge on the Cryodrive.

5. Close the regulator, and unscrew the Helium top-up valve from the Fill and Vent Port.

Note that if the helium pressure has fallen to 0 bar (atmospheric pressure), the helium should not be topped up. Instead, contact Oxford Cryosystems for advice on how to proceed.

5.4 Cryodrive Fault-Finding Schedule

Symptom	Possible Fault	Action
Cryodrive fails to start when switch on. Cryodrive on LED does not flash or light.	Cryodrive protection switch is tripping on overload.	Isolate electrical supply to Cryodrive. Check transformer tap connection, see Table 6.
Or	Returns to OFF position.	Check protection switch overload setting and reset protection see Table 7.
Cryodrive starts when switched on but stops after several minutes of operation. 'Cryodrive on' LED goes out.	Electrical supply fuses or circuit breakers in electrical supply outlet are tripping.	Check cooling water is not too cold, increase water temperature to above +4°C. Check electrical supply voltage. Overload devices in supply outlet should be as detailed in Section 3.6.
Cryodrive fails to start when switched on. 'Cryodrive on' LED flashes and then is continuously lit.	A Cryodrive fuse has blown.	Isolate electrical supply. Check and replace fuse 5A. Check electrical supply voltage; adjust CryoController transformer taps to match electrical supply voltage, as described in Section 3.6.
Cryodrive fails on start when switch on. 'Cryodrive on' LED flashes then goes out. Or	Compressor has over-heated. 'High temperature' LED is lit. Cryodrive is low on helium. 'Low pressure' LED is lit.	Turn off the Cryodrive. Check cooling water and allow Cryodrive to cool. Re-start Cryodrive. Turn off Cryodrive, check helium pressure is 16.5 ±1.0 bar. Re-fill if necessary. Re-start Cryodrive.
Cryodrive starts when switched on but stops after several minutes of operation. 'Cryodrive on' LED goes out.	Compressor is below +8°C. 'High temperature' LED is lit.	Ensure that cooling water colder than +4°C is not circulated while the Cryodrive is shut down. If this occurs, shut off water and allow the Cryodrive to warm up to ambient temperature, re-start Cryodrive then turn on cooling water supply.

Coldhead is not operational	A CryoController fuse has blown.	Isolate electrical supply, check and replace fuse with 5A.
	Coldhead cables not connected.	Check cables are correctly connected. Activate Cryodrive from PLCComm.
	Coldhead motor is defective	Check motor pin resistances. Should be: A-B nominally C-D nominally If the motor is defective, contact Oxford Cryosystems Ltd.

Table 8 – Cryodrive fault-finding schedule

6 Storage and disposal

6.1 Storage

Follow the procedure below to store the Cryodrive.

Shut-down the Cryodrive as described in Section 4 and disconnect all services and connection to Coldhead(s)..

Ensure the cooling water circuit is completely drained of water. Residual water can be blown out using a compressed air line into either the supply or return connection at the rear of the Cryodrive.

Store the Cryodrive in cool, dry conditions until required for use. When required, prepare and install the Cryodrive as described in Section 3.

6.2 Disposal

The Cryodrive, Adsorber and helium gas are at high pressure. The Cryodrive must be de-pressurised before disposal.

To de-pressurise, you must use the charge and vent adapter or the de-pressurisation adapter supplied with a replacement Adsorber to vent the helium gas. When you vent helium ensure that the vented gas is directed safely away from personnel.

The Cryodrive is constructed steels, copper, glass fibre, charcoal, soft solder, mineral oil lubricant and miscellaneous electrical components.

Dispose of the Cryodrive and any components in a safe manner in accordance with all local and national safety and environmental requirements.

7 How to connect and disconnect a self-sealing coupling

You must use two spanners for this operation to avoid leakage and damage to the coupling and pipe work. A small amount of gas may leak from the coupling whilst it is being disconnected; complete the procedure quickly to prevent excessive gas loss.

7.1 Disconnecting a self-sealing coupling

Take the two spanners and place them on the female self-sealing coupling as shown in Figure 19.

Hold a spanner (25.4 mm, 1 inch AF) stationary (red arrow) and turn a second spanner (30 mm, 13/16-inch AF, green arrow) to unscrew the two halves on the coupling. Whilst disconnecting ensure male ensure that the mating coupling male half does not rotate. If rotation occurs, stop immediately and tighten the male half of the coupling before proceeding; if you do not, serious Helium gas loss may occur.

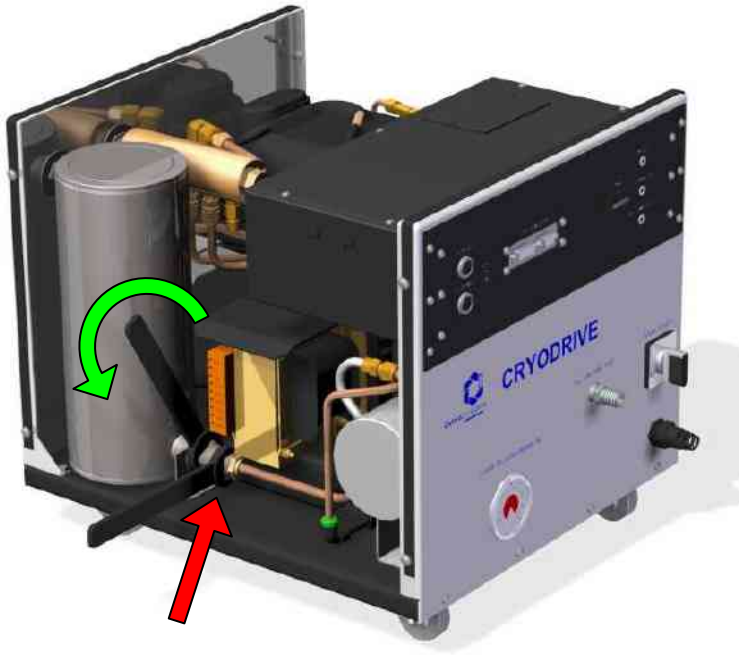

Figure 19 – Disconnecting a self-sealing coupling

7.2 Connecting a self-sealing coupling

Check that the internal surfaces of two halves of the coupling are clean and that the rubber gasket is in place. Connect the coupling halves by hand until resistance is felt. Follow the procedure given for disconnection but rotate the spanner in the opposite direction to connect the fitting. Tighten coupling fully and then uncouple one turn to ensure sealing 'O' ring is not over compressed or the service life of the fittings will be reduced.

8 Equipment return procedure

8.1 Introduction

Before you return your equipment you must warn Oxford Cryosystems Ltd if the substances you used (and produced) in the equipment can be dangerous. You must do this to comply with health and safety at work laws.

You must complete the Declaration (available on page 42) and email or fax this before you dispatch the equipment. If the Declaration is not completed correctly, there may be a delay in processing your equipment.

8.1.1 Oxford Cryosystems Ltd contact details:

Email: support@oxcryo.com

Phone: +44 (0)1993 883488

Fax: +44 (0)1993 883988

8.2 Guidelines

Take note of the following guidelines:

Your equipment is 'uncontaminated' if it has not been used or if it has only been used with substances that are not dangerous. Your equipment is 'contaminated' if it has been used with any dangerous substances.

If your equipment has been used with radioactive substances, you must decontaminate it before you return it to us. You must send independent proof of decontamination (for example a certificate of analysis) to us with the Declaration form. If you require more information please phone or email for advice.

We recommend that contaminated equipment be transported in vehicles where the driver does not share the same air space as the equipment.

8.3 Returns procedure

Use the following procedure:

1. Contact Oxford Cryosystems Ltd and obtain a Return ID number for your equipment.

2. Turn to the next page, photocopy and then complete the Declaration.

3. Remove all traces of dangerous gases: pass an inert gas through the equipment and any accessories that will be returned to Oxford Cryosystems Ltd. Drain all fluids and lubricants from the equipment and its accessories.

4. Disconnect all accessories from the equipment. Safely dispose of the filter elements from any oil mist filters.

5. Seal up all of the equipment's inlets and outlets (including those where accessories were attached). You may seal the inlets and outlets with blanking flanges or heavy gauge PVC tape.

6. Seal contaminated equipment in a thick polythene bag. If you do not have a polythene bag large enough to contain the equipment, you can use a thick polythene sheet.

7. If the equipment is large, strap the equipment and its accessories to a wooden pallet. Preferably, the pallet should be no larger than 510mm x 915mm (20"x 35"); contact Oxford Cryosystems Ltd if you cannot meet this requirement.

8. If the equipment is too small to be strapped to a pallet, pack it in a suitable strong box.

9. If the equipment is contaminated, label the pallet (or box) in accordance with laws covering the transport of dangerous substances.

10. Fax or email a copy of the Declaration form to Oxford Cryosystems Ltd. **The Declaration must arrive before the equipment.**

Give a copy of the Declaration to the carrier. You must tell the carrier if the equipment is contaminated.

Seal the original Declaration in a suitable envelope; attach the envelope securely to the outside of the equipment package.

WRITE YOUR RETURN ID NUMBER CLEARLY ON THE OUTSIDE OF THE ENVELOPE AND ON THE OUTSIDE OF THE EQUIPMENT PACKAGE.

Return of Oxford Cryosystems Equipment Declaration

Customer Name:	Return ID Number: ***>Obtain this from Oxford Cryosystems before sending***

You must:
Know about all of the substances which have been used and produced in the equipment before you complete this Declaration

- Read the Procedure on the previous page before you attempt to complete this Declaration
- Contact Oxford Cryosystems Ltd to obtain a Return ID Number and to obtain advice if you have any questions
- Send this form to Oxford Cryosystems Ltd before you return your equipment

SECTION 1: EQUIPMENT

Equipment model: _____
Serial Number: _____
Has the equipment been used, tested or operated? Yes □ Go to Section 2 No □ Go to Section 4

SECTION 2: SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Are any of the substances used or produced in the equipment

- Radioactive Yes □ No □
- Biologically active Yes □ No □
- Dangerous to human health and safety? Yes □ No □

If you have answered 'No' to all of these questions, go to Section 4.

Oxford Cryosystems Ltd will not accept delivery of any equipment that is contaminated with radioactive substances, unless you:

- Decontaminate the equipment
- Provide proof of decontamination

YOU MUST CONTACT OXFORD CRYOSYSTEMS LTD FOR ADVICE BEFORE YOU RETURN SUCH EQUIPMENT

SECTION 3: LIST OF SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Substance name	Chemical symbol	Precautions required (for example, use protective gloves, etc.)	Action required after spillage or human contact
1			
2			
3			
4			
5			
6			

SECTION 4: RETURN INFORMATION

Reason for return and symptoms of malfunction: _____
_____
If you have a warranty claim:

- Who did you buy the equipment from? _____
- Give Oxford Cryosystems' invoice number: _____

SECTION 5: DECLERATION

Print your name: _____

Print your organization: _____

Print your address: _____

_____

Telephone number:_____
Date of equipment delivery: ___ /___ /_____
I have made reasonable inquiry and I have supplied accurate information in this Declaration. I have not withheld any information. I have followed the Return of Oxford Cryosystems Equipment Procedure on the previous page.
Signed: _____ Date: ___ /___ /_____

Declaration of EMC Conformity

Declare under our sole responsibility that the product

1.5 kW Cryodrive

2.0 kW Cryodrive

3.0 kW Cryodrive

To which this declaration relates, is in conformity with the following standards, or other normative documents.

EN 1012-2 Compressors and vacuum pumps – Safety

requirements - Part 2: Vacuum pumps.

EN / IEC 61010-1 Safety requirements for Electrical Equipment for

Measurement Control and Laboratory Use

EN 61326 Electrical equipment for measurement, control and laboratory use. EMC requirements.

FOLLOWING THE PROVISIONS OF

73/23/EEC Low voltage (electrical safety) Directive

89/336/EEC Machinery Safety Directive

DECEMBER 2010

Richard Glazer, Managing Director, Oxford Cryosystems.

Oxford Cryosystems - Warranty Certificate

This warranty is subject to the Oxford Cryosystems Ltd's (OCL) Terms and Conditions of Sale.

OCL warrants to the Buyer that the goods sold for use hereunder will be free from defects in material and workmanship under normal use and operation for 12 months from the date of shipment from OCL's premises.

In order to obtain the benefits of the warranty the Buyer must first notify OCL of the defects. An OCL representative will verify the nature of the defect and if it is covered by this warranty, OCL will issue the Buyer with a Return ID number and provide the Buyer with instructions on how to return the goods to OCL. The Buyer must return the goods according to instructions from OCL, complete with a written description of the claimed defect and Return ID number. The goods should be packed safely, preferably in its original packaging prior to return.

The Buyer shall meet the cost of shipping the defective goods to OCL and OCL will pay any return costs to the Buyer

OCL's obligation under this warranty is limited to its option to repair or replace goods that are proven to be defective when used under normal operating conditions and within specification.. This warranty does not cover any changes made by the customer, depreciation of the goods or claims for compensation.

No warranty is given for damage resulting from misuse or fair wear and tear. In addition, this warranty does not cover any costs incurred in damage arising from the dismantling or reassembly of any of the goods, or for consequential losses of time or materials caused by Cryostream failure.

Registration

In order for us to be able to provide fast and effective service, you should register your system with us. Please send the serial number of the system(s) (found on the back of the Cryodrive) to support@oxcryo.com, together with your full contact details.